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PERFORMNCE ANALYSIS OF IMAGE ENHANCEMENT USING HISTOGRAM EQUALIZATION WITH NEURAL NETWORK

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ABSTRACT

Various enhancement techniques are used for enhancing an image which played with gray scale format. Histogram equalization (HE) technique is one of the best ways to enhance an image. This technique became a popular technique for contrast enhancement because this technique is very effective as well as simple. In the latter case, the input brightness of an image should be preserving to avoid the production of non-existing artifacts in the enhanced image. Although this method preserve the input brightness on the enhanced image with a significant contrast enhancement. The fundamental idea behind of HE technique is to re-map the gray scale levels of an image. HE tries to introduce some defective artifacts and unnatural enhancement. To reduce these drawbacks different brightness preserving methods are used with or without this technique. In this paper histogram equalization method used with neural network to enhance the image and reduce the drawbacks which will be occur in case of histogram equalization method. This study will be done on the basis of some objective parameter & some subjective parameters. Visual quality and computation time are subjective parameter. Peak signal - to- noise ratio (PSNR), Mean squared error (MSE) are an example of objective parameter.

KEYWORDS: HE, PSNR, MSE, Neural Network

INTRODUCTION

The essential motive of image enhancement is converting the input image in a way that the final image is more visible for interpretation by machines as well as human being. In this paper, the method is proposed for enhance an image by equalization its contrast properties through its histogram with the help of neural network, known as neural hamming distance method, which can transforms the image and gives the result with good contrast, so that the image can be visible clearly and read easily. Hamming Distance between both strings of same length is called the number of positions in which the corresponding characters are different. In another way, it quantifies the minimum number of substitutions demanded to change one string into the other one, or the least number of delusions that could have transformed one string into the other strings. The Hamming distance between two words is the number of edges in a minimum way connecting the correlate with vertices. Based on the hamming distance technique this neural technology finds the dark and dull pixel of the image and by handling the pixel value the brightness of the images will get equalized. Brightness is the scale of dissimilarity between white and black in an image. In the absence of contrast the image wouldn't have any divergence between dark and light. In the absence of brightnesseverything would be white, black, or a single shadow of grey anywhere in between.

Brightness is the divergence in optical properties that represents the image in noticeably different approaches. It is the dissimilarity in the contrast level of an image which differentiates in the middle of the brighter and lighter pixels of the image and so it can be categorize as high or low contrast image. Contrast enhancement is basic steps in displaying the digital images and design successfully contrast enhancement needs understanding of human brightness recognition.

Figure 2 shows the action of image enhancement when any enhancement technique applies on figure 1.

Figure 1: Simple Image

Figure 2: Enhanced Image

HISTOGRAM EQUALIZATION

If image X has been given with the probability density function $P(X_m)$ is defined as

$$P(Xm) = \frac{n_m}{n}$$

For m= 0, 1, …, (*L* – 1).

Where $n_m$represents the number of times that the level X_m appears in the input image X and *n* is the total number of samples in the input image. Note that p (X_m) is associated with the histogram of the input image which represents the number of pixels that have a specific intensity X_m. In fact, a plot of nm vs. $X_m$is known histogram of X. Based on the probability density function; the cumulative density function is defined as

$$C(X) = \sum_{j=0}^{m} P(X_j)$$

Where Xm = *x,* for *m* = 0, 1, ….,*L* – 1. Note that c (XL-1) = 1 by definition. HE is a scheme that maps the input image into the entire dynamic range, (X0, XL-1), by using the cumulative density function as a transform function. Let's define a transform function *f*(*x*) based on the cumulative density function as:

$f(x)=X_0 + (X_{L-1} - X_0)c(x)$

Then the output image of the HE:

Y = {Y (i, j)},

Can be expressed as:

$$Y = f(X)$$

$$= \{f(X(i,j))|\forall X(i,j) \varepsilon X\}$$

The high performance of the HE in enhancing the contrast of an image as a consequence of the dynamic range expansion, besides, HE also flattens a histogram. Based on information theory, entropy of message source will get the maximum value when the message has uniform distribution property.

Adaptive Histogram Equalization Method

This technique is a next level of basic Histogram Equalization method. It enhances the brightness of images by converting the values in the operational image. It deals on small data parts (tiles), rather than the whole image. Each tile's brightness is enhanced, so the histogram of the output region approximately same as the specified histogram. Now the neighboring parts are combined using bilinear interpolation in order to neglect the artificially induced boundaries. The brightness, especially in homogeneous areas, can be limited in order to neglect amplifying the noise which can be present in an image.

ARTIFICIAL NEURAL NETWORK

Image Processing uses several techniques and algorithms in order to interpret and understand the information contained in a digital image one of them is Artificial Neural Network. The field of neural networks has, like any other field of science, a long history of development with many ups and downs. The history of neural networks begins in the early 1940’s and thus nearly simultaneously with the history of programmable electronic computers. This technique based on the nervous system. ANN is very useful in the field of digital world. ANN is based on function of biological neural network and hence can be addressed as a program of biological neural system. ANN is a kind of artificial intelligence which generates results with minimum errors.ANN gives increment to the intelligence as an existent property of complex, adaptive system by pointing at generation of implicit processing mechanisms. Neural network systems have been generated for fields such as data compression, fusion, business intelligence, robotics, or even for some form of intuitive problem solving. In computer science, neural networks gained a lot of steam over the last few years in areas such forecasting, data analytics, as well as data mining. It requires minimum manual work and more depends on automatic procedures. It can perform intelligent tasks same as to those performed by the human brain. It is more reliable and may provide better results.

Neural Hammington Distance Method

Neural Hammington Distance Method is based on hamming distance calculation method. The Hamming distance between two strings of equal length is the number of positions at which the corresponding symbols are different. In another way, it measures the minimum number of substitutions needed to change one string into the other, or the minimum number of errors that could have transformed one string into the other. Hamming distance is basically used find out the error and then corrects it. It is simply defined as the number of bits that are different between two bit vectors. The hamming distance

between the two states being sought and the set of error states is used as an assessment function to Guide the search. The states that have a lower hamming distance to the largest enlarged target are processed first. The states with very few bits differing from the enlarged target will require very few cycles to reach that target. When the states have reached an enlarged target the hamming distance will become zero. The Hamming distance between two words ‘a’ and ‘b’ can also be seen as the Hamming weight of ‘a-b’ for an appropriate choice of the ‘–‘operator. Hamming weight analysis of bits is used in several disciplines including information theory, coding theory, and cryptography. The Hamming Distance is a number used to denote the difference between two binary strings. It is a small portion of a broader set of formulas used in information analysis. Specifically, hamming's formula allow computers to detect and correct error on their own. Following are the steps to calculate hamming distance of two strings:-

Ensure the two strings are of equal length. The Hamming distance can only be calculated between two strings of equal length.

String 1: "111100001010"

String 2: "101011110001".

Compare the first bit in each string. If they are the same, record a "0" for that bit. If they are different, record a "1" for that bit. In this case, the first bit of both strings is "1," so record a "0" for the first bit. Compare each bit in succession and record either "1" or "0" as appropriate.

String 1: "111100001010"

String 2: "101011110001"

Record: "010111111111".

Add all the ones and zeros in the record together to obtain the Hamming distance.

Hamming distance = 0+1+0+1+1+1+1+1+1+1+1+1

=10

The proposed neural hammington method uses this hamming distance measurement technique and finds the shortest distance between the layers of neuron from output layer to the input layer and by doing so every pixel of the image is being worked on and the contrast of the image changes.

Flow Chart of Proposed Algorithm

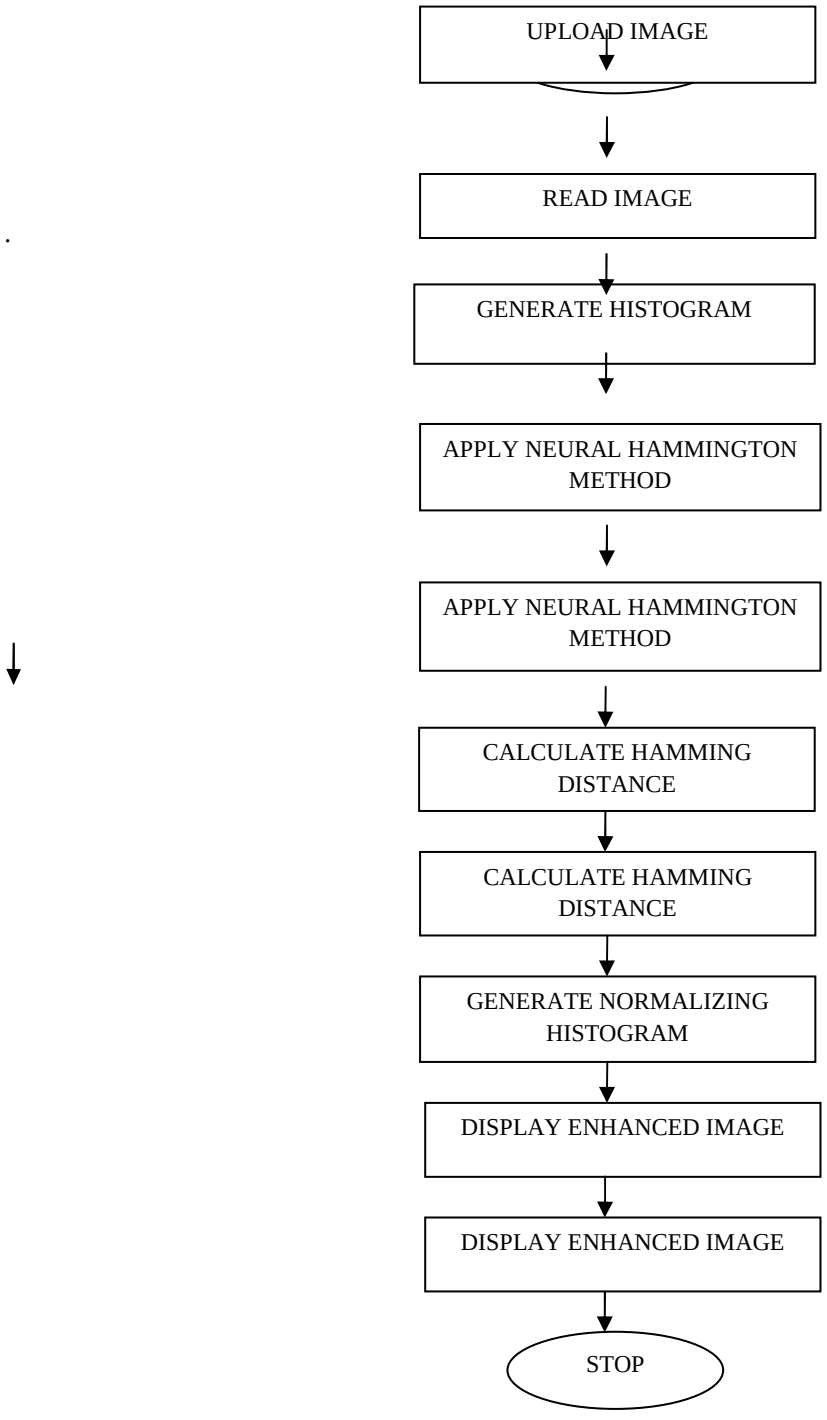

Figure 3: Flow Chart

EXPERIMENTAL RESULT

Experiments are abridge to prove the electiveness of the examined method by applying it to a digital picture image named as “Hanshika .jpg” having size 256*256 shows in figure 1 and its histogram shows in figure 2. It is easily visible that the image is very dim and dark. The face of girl and some background tiles of the image are very dim. For

overcome these darkness the proposed algorithm has been applied on the input image.

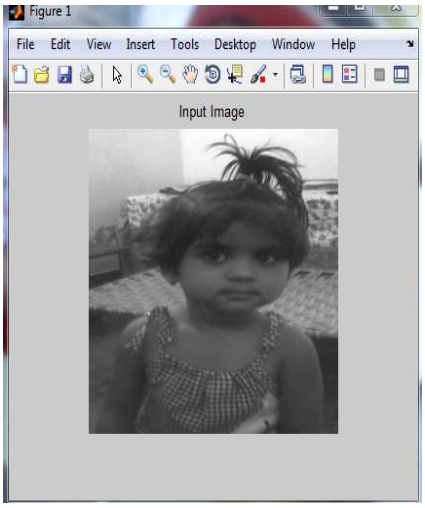

Figure 4: Input Image

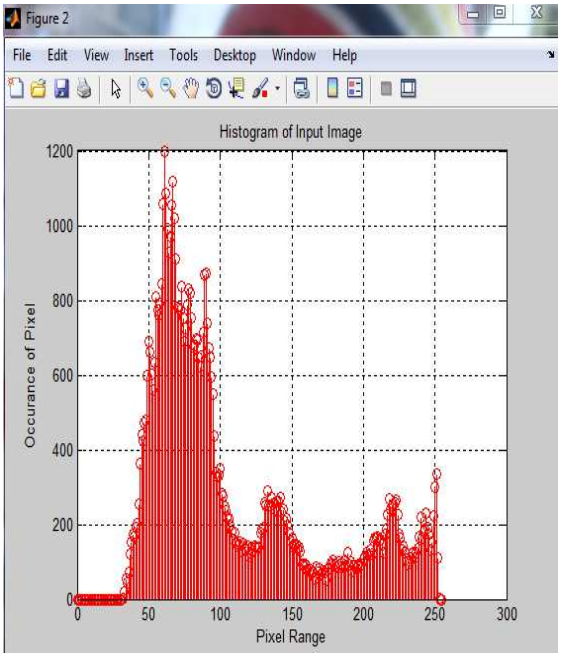

Figure 5: Histogram of Input Image

After applying the proposed algorithm figure 6 has been obtained as named enhanced image having good quality. The histogram of enhanced image shows in figure 7.

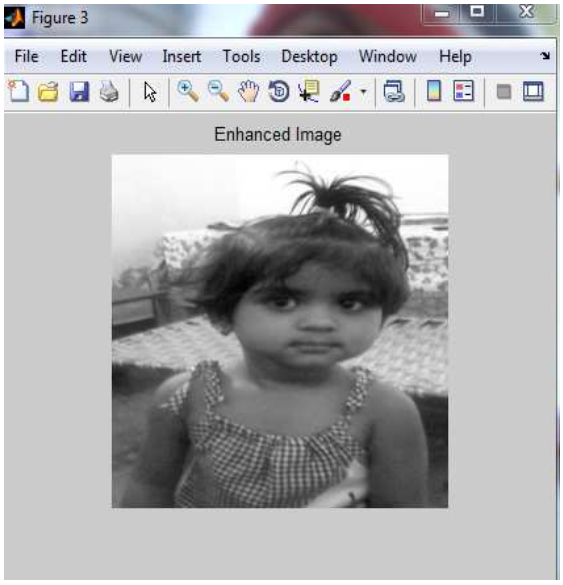

Figure 6: Enhanced Image

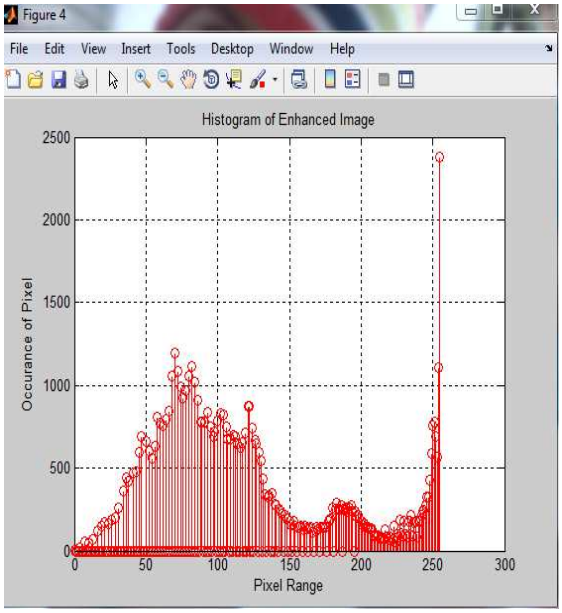

Figure 7: Histogram of Enhanced Image

With the help of experimental result, it is quite clear that the darkness and dullness of original image has been eliminating with the help of proposed algorithm. The histogram of enhanced image clearly shows that the brightness and contrast are well mannered. So the visual effects of the original image have been upgraded very well. For objective parameters consider the figure 5 and figure 7, which show the histogram respectively original and enhanced image. It is very obvious that the image gray scale allocation is more even and the dark gray region distribution in the image is more equitable. There are two error metrics which is used to equate the quality of image enhancement, known as PSNR and MSE. The PSNR represents a measure of the peak error and the MSE represents the cumulative squared error between the original and the enhanced image.

Figure 8 shows the graph of MSE and PSNR values of enhanced image. In the graph blue line have the MSE and red line have the PSNR value.

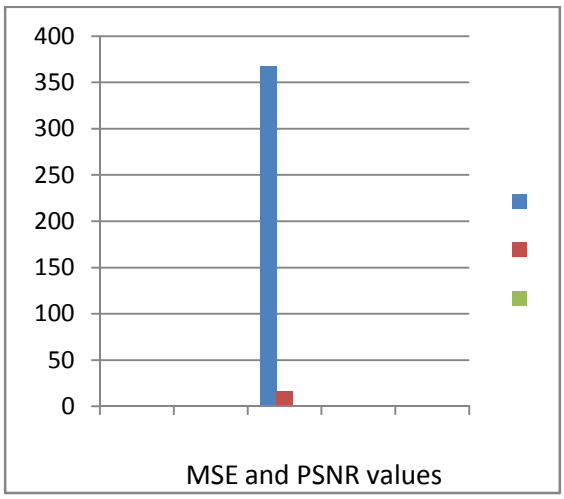

Figure 8: Graph of MSE and PSNR Values

CONCLUSIONS

It has been concluded that Image enhancement is an important technique in digital image processing. There are different types of enhancement techniques but histogram equalization technique is a good enhancement technique in spatial domain.

Also, it has been concluded that the proposed methodology of histogram equalization with neural network is admirably and systematic for equating the contrast and brightness of the given image for enhance to the other equalization methods, as well as the MSE and PSNR values are better after the applied the proposed methodology.

The proposed method has a great future and can be an area of interest for upcoming researchers and new technologies which have been developed new technologies in the field of digital image or its application.

After some innovations in the proposed method, the colour images can also be enhanced by manipulating its RGB scale.

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